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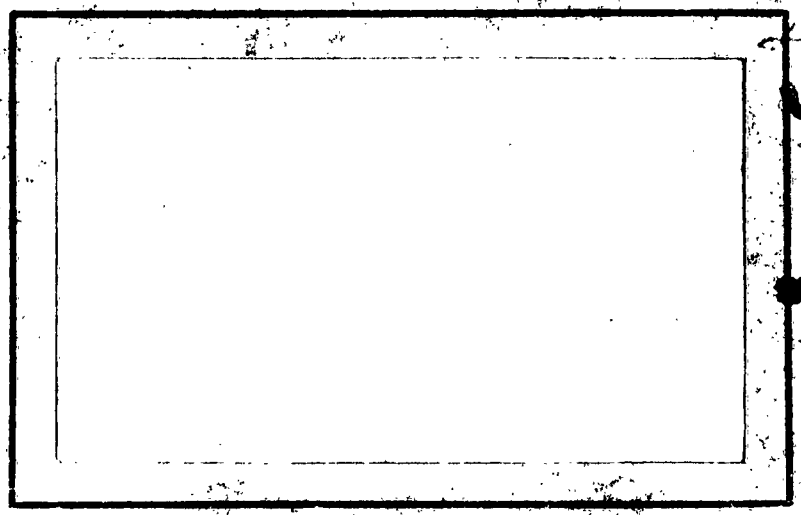

WOODS HOLE, MASSACHUSETTS

WOODS HOLE OCEANOGRAPHIC INSTITUTION

Woods Hole, Massachusetts

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Reference No. 52-43

Hydrographic Survey in the Boston Area

C/1

Results of HAZEL III - Cruise 10

Prepared by D. F. Bumpus and C. G. Day

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Director

Introduction

Temperature, salinity, and transparency measurements were made in the Boston Harbor area during the period 26 February to 2 March 1952. The location of these observations are indicated in Figure 1. Similar observations in this area during other periods were reported in our Interim Report Nos. 1, 4, 5, and 6; WHOI Reference Nos. 51-62, 51-93, 51-94, and 52-19, respectively.

Temperature and Salinity at the Surface

Distribution of temperature at the surface, 26 February to 2 March 1952, in Boston Harbor and approaches is shown in Figure 2. Temperature ranged from less than 33°F. in Hingham Bay to about 35°F. in other parts of Boston Harbor to greater than 37°F. offshore. A line of bathythermograms close to the western shore of Cape Cod and Massachusetts Bays yielded surface temperatures ranging between 35 and 37.5°F.

The surface salinity, Figure 3, was greater than 32 °/oo offshore from a line between Minots Light and Nahant. The 31.0 °/oo isohaline extended from Winthrop south and west into a pocket in Dorchester Bay, thence eastward through President Roads, and finally south through the Narrows into Hingham Bay. In general lower values were found near shore decreasing to less than 27 °/oo in the Inner Harbor off the Charles River at high water. Further upstream there was an increase to 27.3 °/oo in Mystic River.

Distribution of Temperature, Salinity, Density, and Sound Velocity in Boston Harbor and Approaches

In the northern half of the Manchester to Minots Light section, the temperature increased less than one degree between the surface and the bottom, all temperatures being greater than 37°F. and less than 38°F., Figure 4. Toward the southern end of this section the temperature decreased throughout the water column to a virtually isothermal condition at slightly less than 36.0°F.

The salinity increased slightly with depth throughout all but the southern end of the section where the water was virtually isohaline. The salinity increase throughout the section was small, never exceeding 0.20 °/oo between the surface and the bottom.

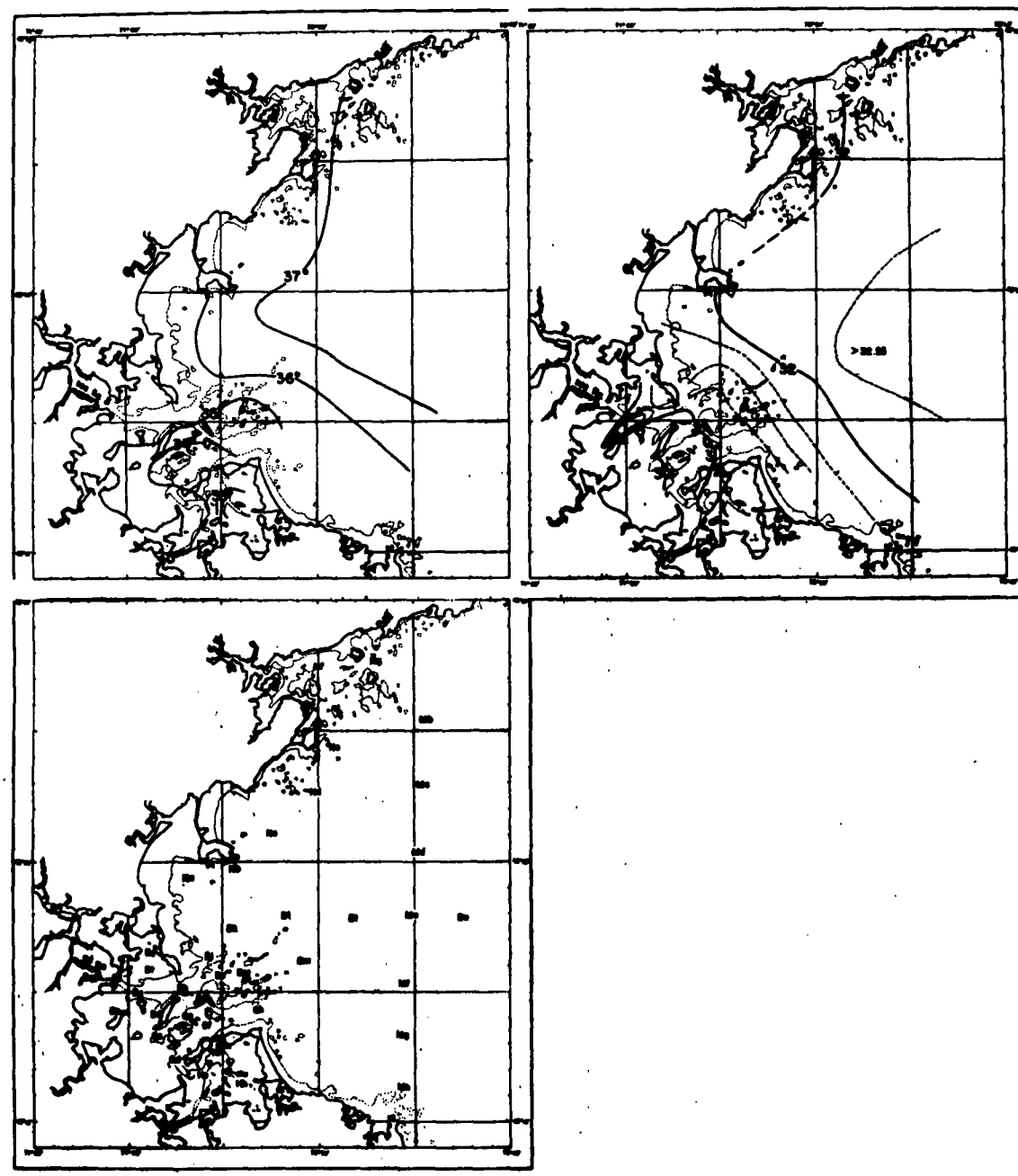

Fig. 1 (lower left). Station locations.

Fig. 2 (upper left). Distribution of temperature (°F.) at the surface.

Fig. 3 (upper right). Distribution of salinity (o/oo) at the surface. HAZEL III - Cruise 10, 26 February - 2 March 1952.

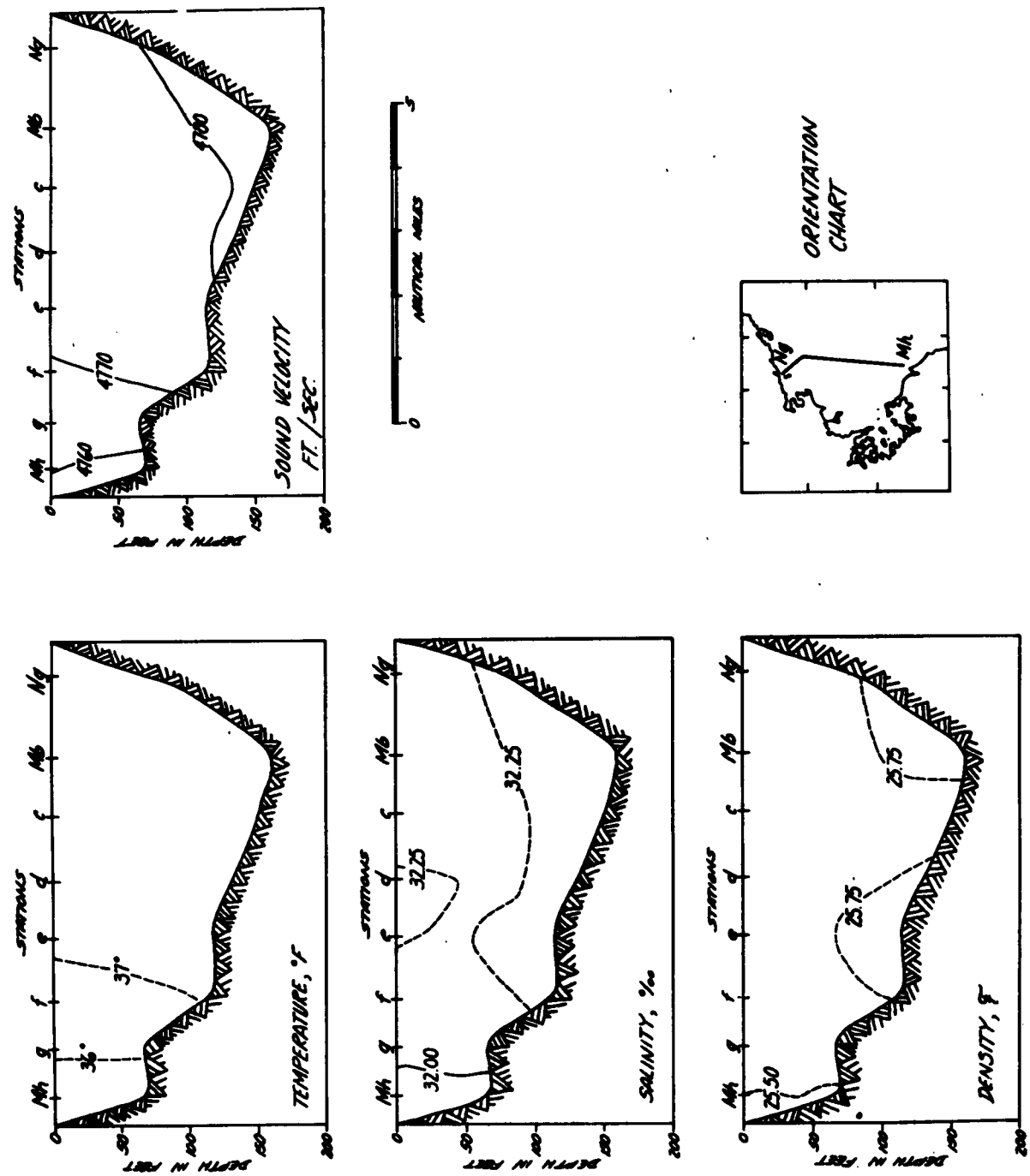

Fig. 4 Distribution of temperature, salinity, density, and sound velocity in the section Minots Light to offing of Manchester, HAZEL III - Cruise 10.

With the exception of the southern end of this section, where the density was least and virtually constant at approximately 25.5 σ_t, the density increased with depth throughout the section from about 25.7 σ_t at the surface to just over 25.77 σ_t at the bottom.

Sound velocity varied in a manner similar to the above mentioned properties. Sound velocity was lowest at the southern end of the section at approximately 4760 feet per second, increasing northward to about 4775 feet per second at the surface, and increasing in depth to a maximum of 4782 feet per second at the bottom.

In general the virtually homogeneous condition reported for all these properties in November persisted. Temperatures in February were about eleven degrees Fahrenheit lower, salinity was slightly greater at the surface and less at the bottom, density was about 0.75 σ_t less throughout, and sound velocity about 80 feet per second less than in November.

In the section from Boston Inner Harbor through North Channel to the longitude of Boston Light Vessel, Figure 5, little variation in temperature occurred, the extreme difference being only 2.7°F. A pocket of water of less than 36°F., overlying warmer water of greater than 36°F., lay on the surface from Mystic River to a point just north of the Charles River in the Inner Harbor. A virtually isothermal column of water of less than 36°F. lay between a point south of Fort Point Channel and the center of North Channel. Temperatures greater than 37°F. appeared in the water offshore where depths exceeded 100 feet. Temperatures increased slightly with depth throughout this area. Two sections were made in the Inner Harbor; one at high water and one at low water on the same day. At high water temperatures were found to be in general about 1°F. warmer.

Salinities in this section ranged from less than 27.5 °/oo at the surface in the Mystic River to greater than 32 °/oo in the deeper water beyond North Channel. Salinity increased with depth in the Inner Harbor 1 to 2.5 °/oo at low water. The increase was greater, 1 to 4 °/oo, at high water due to the accumulation of fresh water on the surface and the intrusion of saline water along the bottom. Offshore there was virtually no vertical salinity gradient.

As there was little temperature variation, the density distribution closely paralleled the salinity pattern. Values for sigma-t ran from a minimum at the surface in Mystic River of 21.87 σ_t to greater than 25.0 σ_t east of Deer Island.

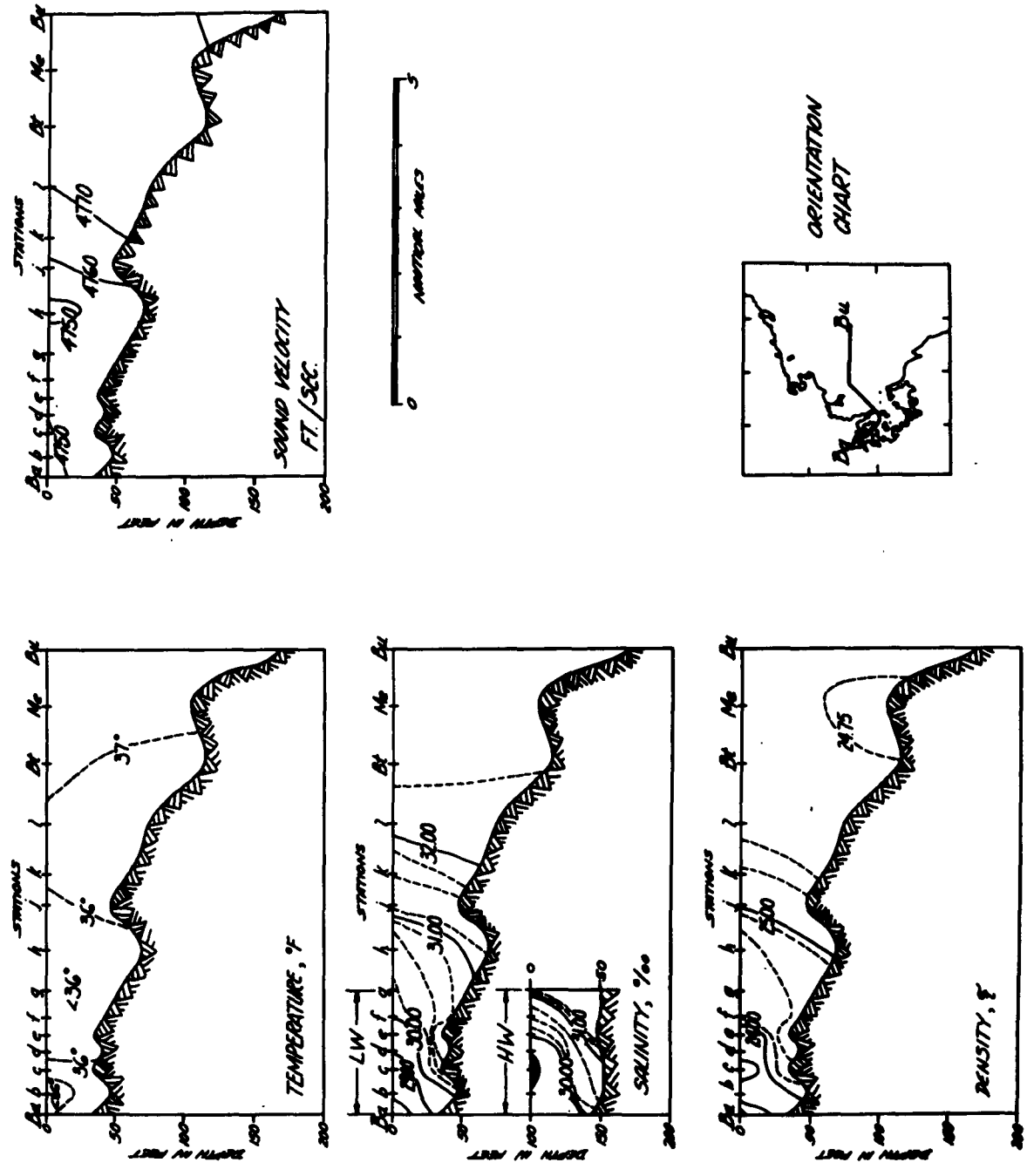

Fig. 5 Distribution of temperature, salinity, density, and sound velocity in the section Chelsea River to longitude of Boston Light Vessel, HAZEL III - Cruise 10.

Stratification amounting to about 1.5 σ_t units in the inshore end of the section diminished seaward to nearly isopycnic conditions offshore.

Sound velocities also followed the salinity pattern, the lowest being 4740 feet per second near the surface in Mystic River showing a slight increase with depth and a slight increase seaward to a maximum of 4778 feet per second at the surface and 4782 feet per second at the bottom.

Attendant Precipitation and Stream Flow

Precipitation and stream flow for New England are available from the Geological Survey Water Bulletin for February 1952. Precipitation averaged about 122 per cent of normal (4.11 inches over Massachusetts). "Two severe northeast storms occurred during the month." Stream flow continued far above normal throughout the district during February. The runoff of representative rivers averaged 180 per cent of normal. Ground water levels which had been rising since autumn started to fall during February. Water levels in Middlesex County were in general lower than they were last year at this time, but remained at or above average.

Net change in month minus 1.35 feet
Net change in year minus 0.65 feet
Departure from February average plus 0.4 feet

Flushing Time of Boston Inner Harbor

Computation of the flushing time of Boston Inner Harbor on the basis of the above reported salinity data and the February runoff data for the New England district are indicated below, using the same method reported in WHOI Reference No. 52-19.

The volume of fresh water in Boston Harbor on 28 February at low water was 149.5 x 10^6cu.ft. or 7.5 per cent of the total volume. At high water it was 154.0 x 10^6cu.ft. or 5.6 per cent of the total volume. The runoff per day for the 300 square mile area tributary to Boston Inner Harbor in February was computed to be 46.2 x 10^6cu.ft. per day. Hence, the flushing time resulting from these data amounts to 3.4 days.

Transparency

Transparency measurements were made in Boston Harbor and approaches with black and white secchi discs. The visibility with the white disc ranged from 2 feet in the Mystic River to 14 feet offshore with intermediate values regularly dispersed in between. The black disc could be seen from one-third to two-thirds of the white disc depths. Transparency of the water was about one-half that observed during the previous cruise in November. It is conjectured that the winter storms had stirred up silt and detritus in the shallow water which spread throughout the whole area, hence reducing the transparency.

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